National Institute of Environmental Health Sciences

Modeling the effects of weather and climate change on malaria transmission

Author(s): Parham PE, Michael E
Year: 2010
Journal: Environmental Health Perspectives. 118 (5): 620-626

Abstract:

BACKGROUND: In recent years, the impact of climate change on human health has attracted considerable attention; the effects on malaria have been of particular interest because of its disease burden and its transmission sensitivity to environmental conditions. OBJECTIVES: We investigated and illustrated the role that dynamic process-based mathematical models can play in providing strategic insights into the effects of climate change on malaria transmission. METHODS: We evaluated a relatively simple model that permitted valuable and novel insights into the simultaneous effects of rainfall and temperature on mosquito population dynamics, malaria invasion, persistence and local seasonal extinction, and the impact of seasonality on transmission. We illustrated how large-scale climate simulations and infectious disease systems may be modeled and analyzed and how these methods may be applied to predicting changes in the basic reproduction number of malaria across Tanzania. RESULTS: We found extinction to be more strongly dependent on rainfall than on temperature and identified a temperature window of around 32-33 degrees C where endemic transmission and the rate of spread in disease-free regions is optimized. This window was the same for Plasmodium falciparum and P. vivax, but mosquito density played a stronger role in driving the rate of malaria spread than did the Plasmodium species. The results improved our understanding of how temperature shifts affect the global distribution of at-risk regions, as well as how rapidly malaria outbreaks take off within vulnerable populations. CONCLUSIONS: Disease emergence, extinction, and transmission all depend strongly on climate. Mathematical models offer powerful tools for understanding geographic shifts in incidence as climate changes. Nonlinear dependences of transmission on climate necessitates consideration of both changing climate trends and variability across time scales of interest.

Source: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866676

Resource Description

Early Warning System: ☒

resource focus on systems used to warn populations of high temperatures, extreme weather, or other elements of climate change to prevent harm to health

A focus of content

Exposure : ☒

weather or climate related pathway by which climate change affects health

Ecosystem Changes, Precipitation, Temperature

Temperature: Fluctuations

Geographic Feature:

resource focuses on specific type of geography

None or Unspecified

Geographic Location:

resource focuses on specific location

Non-United States

Non-United States: Africa

African Region/Country: African Country

Other African Country: Tanzania

Health Impact:

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Vectorborne Disease

Vectorborne Disease: Mosquito-borne Disease

Mosquito-borne Disease: Malaria

Mitigation/Adaptation:

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology:

type of model used or methodology development is a focus of resource

Exposure Change Prediction, Methodology

Resource Type:

format or standard characteristic of resource

Research Article

Timescale:

time period studied

Short-Term (

Vulnerability/Impact Assessment:

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content